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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/569,548	02/27/2006	Kenzo Maehashi	12480000162US	7724

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EXAMINER	
WONG, EDNA	

ART UNIT	PAPER NUMBER
1795	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/569,548	MAEHASHI ET AL.	
	Examiner	**Art Unit**	
	EDNA WONG	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _Pre-Appeal Brief Request dated 4/9/10_.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1-18_ is/are pending in the application.

4a) Of the above claim(s) _7 and 8_ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _1-6 and 9-18_ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

This is in response to the Pre-Appeal Brief Request dated April 9, 2010. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office Action.

The finality of the rejection of the last Office action is withdrawn in view of the new grounds of rejection.

Response to Arguments

Election/Restrictions

This application contains claims **7 and 8** drawn to an invention nonelected without traverse in the reply filed on May 7, 2009.

Claim Rejections - 35 USC § 103

Claims **1-6 and 9-18** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Yudasaka et al.** ("Diameter-Selective Removal of Single-Wall Carbon Nanotubes Through Light-Assisted Oxidation", Chemical Physics Letters (June 4, 2003), Vol. 374, Issues 1-2, pp. 132-136) in view of **Bokova et al.** ("Laser-Induced Effects in Raman Spectra of Single-Wall Carbon Nanotubes", Quantum Electronics (July 31, 2003), Vol. 33, No. 7, pp. 645-650), **Irle et al.** ("Theoretical Study of Structure and Raman Spectra for Models of Carbon Nanotubes in Their Pristine and Oxidized Forms", J. Phys. Chem. A (2002), Vol. 106, pp. 11973-11980), and **Howard et al.** (US

Patent No. 7,396,520 B2).

The rejection of claims 1-6 and 9-18 under 35 U.S.C. 103(a) as being unpatentable over Yudasaka et al. in view of Bokova et al., Irle et al., and Howard et al. has been withdrawn in view of the new grounds of rejection.

Response to Amendment

Claim Rejections - 35 USC § 103

Claims **1-6 and 9-18** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Bokova et al.** ("Laser-Induced Effects in Raman Spectra of Single-Wall Carbon Nanotubes", Quantum Electronics (July 31, 2003), Vol. 33, No. 7, pp. 645-650) in view of **Irle et al.** ("Theoretical Study of Structure and Raman Spectra for Models of Carbon Nanotubes in Their Pristine and Oxidized Forms", *J. Phys. Chem. A* (2002), Vol. 106, pp. 11973-11980).

Bokova teaches a structure control method comprising:

• measuring a first Raman spectrum (= *all the materials were preliminary investigated by* the methods of high-resolution electron microscopy and *Raman spectroscopy* using low-power laser excitation) of a mixture of nano-scale low-dimensional quantum structures of differing densities of states (= single-wall carbon nanotubes of three types synthesized by the methods of laser ablation [16], arc synthesis [17], and the catalytic high-pressure decomposition of CO (HipCO) [18]);

• irradiating the mixture of nano-scale low-dimensional quantum structures of

differing densities of states with an electromagnetic wave (= radiation from a cw argon laser) in air (= in air) after measuring a first Raman spectrum (page 646, "2. Experimental"), the electromagnetic wave having an energy density of 10 kW/cm^2 (= in the first spectrum excited at a power density of 10 kW cm^{-2}, the 187-cm^{-1} breathing mode dominates, which corresponds to nanotubes of diameter 1.32 nm) [page 648, "3.2 "Reversible changes in Raman spectra of single-wall carbon nanotubes caused by laser radiation"], so as to selectively oxidize a low-dimensional quantum structure of a density of states resonating with the electromagnetic wave (= we have found by the method of Raman spectroscopy that the threshold temperature of *selective oxidising annealing* of HipCO nanotubes by laser irradiation depends on the nanotube diameter and can be determined from the frequency of a tangential Raman mode of nanotubes at the instant disappearance of the corresponding breathing mode) [page 648, left column, lines 4-11]; and

• measuring a second Raman spectrum of the irradiated mixture of nano-scale low-dimensional quantum structures (= dependences of the shape of breathing Raman modes of single-wall carbon nanotubes synthesized by the method of laser ablation on the laser excitation wavelength (a) and the 514.5-nm laser power density (b)) [page 648, Fig. 6].

The selective oxidation removes from the mixture the low-dimensional quantum structure of a density of states resonating with the electromagnetic wave (= we found in our experiments that *the selective resonance response of nanotubes* can be tuned not

only by scanning the laser excitation frequency but also by varying the laser power density (the laser wavelength being fixed) [26]) (page 648, “3.2 “Reversible changes in Raman spectra of single-wall carbon nanotubes caused by laser radiation”).

The low-dimensional quantum structures comprise nanotubes or nanoparticles (= single-wall carbon *nanotubes* of three types synthesized by the methods of laser ablation [16], arc synthesis [17], and the catalytic high-pressure decomposition of CO (HipCO) [18]) [page 646, “2. Experimental”].

The low-dimensional quantum structures comprise carbon or boron nitride (= single-wall *carbon* nanotubes of three types synthesized by the methods of laser ablation [16], arc synthesis [17], and the catalytic high-pressure decomposition of CO (HipCO) [18]) [page 646, “2. Experimental”].

The low-dimensional quantum structures have a single-walled structure (= *single-wall* carbon nanotubes of three types synthesized by the methods of laser ablation [16], arc synthesis [17], and the catalytic high-pressure decomposition of CO (HipCO) [18]) [page 646, “2. Experimental”].

The electromagnetic wave is a laser beam (= a cw argon laser) [page 646, “2. Experimental”].

The nanotubes or nanoparticles have a single-walled structure (= *single-wall* carbon *nanotubes* of three types synthesized by the methods of laser ablation [16], arc synthesis [17], and the catalytic high-pressure decomposition of CO (HipCO) [18]) [page 646, “2. Experimental”].

The method of Bokova differs from the instant invention because Bokova does not disclose the following:

a. Wherein the irradiating is *for two hours*, as recited in claim ***1***.

Bokova teaches the step of irradiating the mixture of nano-scale low-dimensional quantum structures of differing densities of states with an electromagnetic wave in air after measuring the first Raman spectrum, the electromagnetic wave having an energy density of 10 kW/cm^2 so as to selectively oxidize a low-dimensional quantum structure of a density of states resonating with the electromagnetic wave (page 646, "2. Experimental"; and page 648, "3.2 "Reversible changes in Raman spectra of single-wall carbon nanotubes caused by laser radiation").

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the irradiating described by Bokova with wherein the irradiating is for two hours because the irradiation time is a result-effective variable and one having ordinary skill in the art has the skill to calculate the irradiation time that would have determined the success of the desired reaction to occur, e.g., synthesis of monodispersed nanotubes with a specified diameter (Bokova: pages 645-646, "1. Introduction"; and page 648, left column, lines 4-10) and the shape of the Raman breathing modes (MPEP § 2141.03 and § 2144.05).

Furthermore, the irradiating step described by Bokova is inherently carried out for a time. It is held that changes in the irradiation time is not a patentable modification; however, such changes may impart patentability to a process if the ranges claimed

produce new and unexpected results which are different in kind and not merely in degree from results of the prior art, such ranges are termed "critical" ranges and Applicant has the burden of proving such criticality; even though Applicant's modification results in great improvement and utility over the prior art, it may still not be patentable if the modification was within capabilities of one skilled in the art; more particularly, where general conditions of the claim are disclosed in the prior art, it is not inventive to discover optimum or workable ranges by routine experimentation. *In re Aller*, 220 F2d 454, 456, 105 USPQ 233, 235 (CCPA 1955) [MPEP § 2144.05].

b. Measuring a reduction in peak intensity of the second Raman spectrum to confirm the selective oxidation of the low-dimensional quantum structure, as recited in claim ***1***.

Bokova teaches that:

> *Depending on the geometry, nanotubes can be either semiconductors or metals*. This property is crucial for the development of nanoelectronic elements and devices such as diodes, transistors, and logical circuits. The geometrical parameters of nanotubes should be strictly controlled in manufacturing such elements. However, up to now, there have been no methods for synthesis of monodisperse nanotubes with a specified diameter. *The homogeneity of a material can be substantially improved by performing its structuring using, for example, laser radiation*. Laser radiation can be simultaneously used to modify the material and excite its Raman spectrum, which characterizes this modification. *It is known that Raman spectra give information on the diameter and chirality of individual nanotubes, the type of their conductivity and the size of their bundles, the distribution of nanotubes over their diameters in a particular sample, and the purity of the material* (pages 645-646, "1. Introduction").

Like Bokova, ***Irle*** teaches carbon nanotubes in their pristine and oxidized forms.

Irle teaches that *upon oxidation calculated Raman spectra show large reduction in peak intensities*, which can be attributed to the loss of cylindrical symmetry due to structural deformation. The study provides a novel explanation that Raman spectra of individual CNT's are highly sensitive to oxidation (page 11973, abstract).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Bokova by measuring a reduction in peak intensity of the second Raman spectrum to confirm the selective oxidation of the low-dimensional quantum structure because this would have gained insight into the changes in geometries upon oxidation of the nanotubes as taught by Bokova (page 645-646, “1. Introduction”) and Irle (pages 11979-11980, “V. Summary and Perspective”).

Citations

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Osadchy et al. (“Modeling of Electron Density of States for Single-Wall Carbon and Boron Nitride Nanotubes”, JETP Letters (April 2003), Vol. 77, No. 8, pp. 405-410) is cited to teach that for the determination of not only the diameter but also the chirality (the torsion angle) of a given nanotube from the Raman spectra, one needs data on the electronic density of states for this tube [6] (page 405, bridging paragraph).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to EDNA WONG whose telephone number is (571) 272-1349. The examiner can normally be reached on Mon-Fri 7:30 am to 4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Edna Wong/
Primary Examiner
Art Unit 1795

EW
May 10, 2010